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Background

The County of Lambton has operated a landfill site near the city of Sarnia for about 20 years. Because the site will be full in a year or two, the County has submitted an application for expansion to the Ministry of the Environment to accommodate future needs.

However, nearby residents and other concerned citizens have expressed opposition to the expansion. In part, their opposition is based on the recent decline and death of trees along the edge of a small woodlot situated adjacent to the east side of the landfill site. Although the woodlot property is owned by the County, opponents feel that the decline and death of the trees may be related to emissions from the landfill site. If so, expansion of the site may be perceived to exacerbate environmental problems.

Based on the concerns of the residents about the dead and dying trees in the woodlot, the Sarnia office of the Ministry felt it was important to determine the cause of the declining woodlot trees and investigate the role of possible emissions from the existing landfill site. The Sarnia office contacted the Phytotoxicology Section and requested an investigation.

Phytotoxicology Investigation

Phytotoxicology investigators A. Kuja and G. Vasiloff visited the Lambton County landfill site on September 10, 1991. Figure 1 shows the location of the small woodlot in relation to the landfill site and associated structures. A number of dead and dying silver maple trees were examined at three distinct locations (Sites A, B and C) within the woodlot located immediately east of the landfill site.

It was clear from the investigation that the dead and dying trees were not distributed throughout the woodlot. Rather, the affected trees appeared to be confined to three

defined areas. Examination of the sites indicated that each was at a lower grade level than the surrounding area. In each case, the sites were extremely muddy and wet.

The greatest number of affected trees were situated at Sites B and C. At Site B, standing water covered the area surrounding the trees. At Site C, the soil was very muddy and water marks visible on tree trunks indicated that the flood waters had been at least 40 cm deep. At Site D, no dead or declining trees were observed. However, the soil was muddy and high water marks were visible on tree trunks.

Although overflow waters from the north pond empties into the low area at Site A, it was obvious that this has been a natural drainage course for a considerable period. The drainage area forks to the southeast and southwest within the woodlot. The fork to the southeast is open and grassy. The southwest fork appears newer because of dead trees along the course. Waters flowing in this direction drain into the low area at Site B.

Because Site A is an older, established drainage area, the invasion of water-loving plants is complete. At site locations B and C, it was evident that a current process of succession was taking place. A number of plant species commonly found in wet habitats have become established. These included common reed (Phragmites australis), sedge (Carex retrosra), black bulrush (Scirpus atrovirens), river bulrush (Scirpus fluviatilis) and great water dock (Rumex orbiculata). These or other wet-site plants were not found elsewhere within the woodlot.

It was observed that the affected trees were only situated in low areas, and it was apparent that in the past several years, these areas have remained extremely wet as a result of a continuing source of water. Trees inundated by intermittent flooding usually suffer injury. However, trees subjected to permanently flooded soils or soils wet for long periods, usually die.

Tree cores were collected from four silver maple trees at Site C in order to examine the incremental growth relationships between flooded and non-flooded (control) specimens. It was anticipated that the tree's growth rings would show that the incremental growth of the two trees in the low, wet area was normal prior to the date when the flooding started, and the growth rings would be narrower in the post-flood period. Unfortunately, growth rings formed during the last five years were so faint that they could not be measured with confidence. On two of the trees, over 95% of the crowns had not produced foliage. Another tree was located at the fringe of the low, wet area, but the crown appeared full and healthy. The fourth tree was located on higher ground inside the woodlot had never experienced any flooding.

To determine whether the death and decline of the woodlot trees was related to liquid emissions (leachate) from the landfill site, vegetation in the vicinity of the affected trees was examined. Since leachate would not be selective (affect only the silver maple trees), other indigenous vegetation exposed to the flood waters (or leachate) would have also been affected. All vegetation was examined for evidence of chemically-induced foliar injury, but none was observed.

Since the decline and death of the woodlot silver maples by flooding has only taken place in the last few years, adjacent sites were examined to determine recent drainage pattern changes that could account for the flooding within the woodlot.

General Site Observations

Examination of the berm and other landfill site-related structures adjacent to the woodlot indicated that grade changes had caused surface drainage waters from a number of locations to collect at the edge of the woodlot. Figure 2 is a view of the landfill site showing the groundwater potentiometric surface. This figure shows elevations of the perimeter areas of the landfill site and drainage flow directions.

The eastern perimeter of the landfill site consists of a massive berm that angles down severely to near the edge of the woodlot. Locations along the berm are identified as Site E in the figure 1. Several years ago, a keyed berm was installed along this stretch of this structure. This procedure involves the excavation of clay from a trench along the berm down to the compacted clay base. The excavated clay is compacted and placed back within the trench. A leachate collection pipe is installed in the middle of the compacted clay in the trench. From an engineering standpoint, a keyed berm constructed in this manner is considered impervious to the penetration of leachate from the landfill site. Sarnia Ministry staff have indicated that the keying was undertaken to prevent leachate from leaking from the landfill site. Although the decline of the trees is not a direct result of the construction, grade changes associated with the construction likely caused additional surface waters to collect within the low areas of the woodlot.

Further north along the berm (Site F, Figure 1), the base of the berm was graded in such a way that surface water is channelled and flows in a southerly direction and ultimately drains into the western edge of the woodlot.

Immediately north and south of the woodlot, the County has constructed two sedimentation ponds. The southern pond (Site G) was being enlarged during the Phytotoxicology visit. This pond was intended to collect surface waters from the landfill and accept treated water from the leachate treatment plant at the site. A series of overflow pipes have been installed at the north end of the pond to drain away excess water. The pipes lead to an external rock bed that is slightly higher than the grade of the adjacent woodlot. Therefore, overflow waters from the pond would drain into the woodlot. Trees examined along this location indicate that water had been at least 40 cm high at some point during the past growing season.

The smaller pond, north of the woodlot (Site H) was constructed in a similar fashion to the south pond. Discharge from the overflow pipes and rock bed flow directly to the woodlot because of the grade differential. Although high water marks were not observed on woodlot trees, the two paths taken by the waters were clearly defined. Waters flowing along the southwest route appeared to gravitate to the low area at Site B.

Conclusions

Phytotoxicology investigators examined dead and dying silver maple trees in a small woodlot adjacent to the Lambton County landfill site. Physical evidence indicated that grade changes of the berm along the eastern perimeter of the site and the discharge from two settling ponds had resulted in the flooding of low areas in the woodlot. Although silver maple are able to withstand intermittent flooding, it appears that the affected trees have been subjected to flooded soils over a protracted period of time. The wet conditions have already killed some of the trees. Other trees that are under considerable stress will eventually succumb if the flooding persists. No evidence of foliar injury related to toxic leachate was observed on vegetation located between the landfill site and the woodlot.

The construction of an adequate drainage to direct storm water around the woodlot and other appropriate locations should prevent further flooding and loss of trees.

FIGURE: 1 Location of Woodlot in Relation to Lambton County Lanfill Site

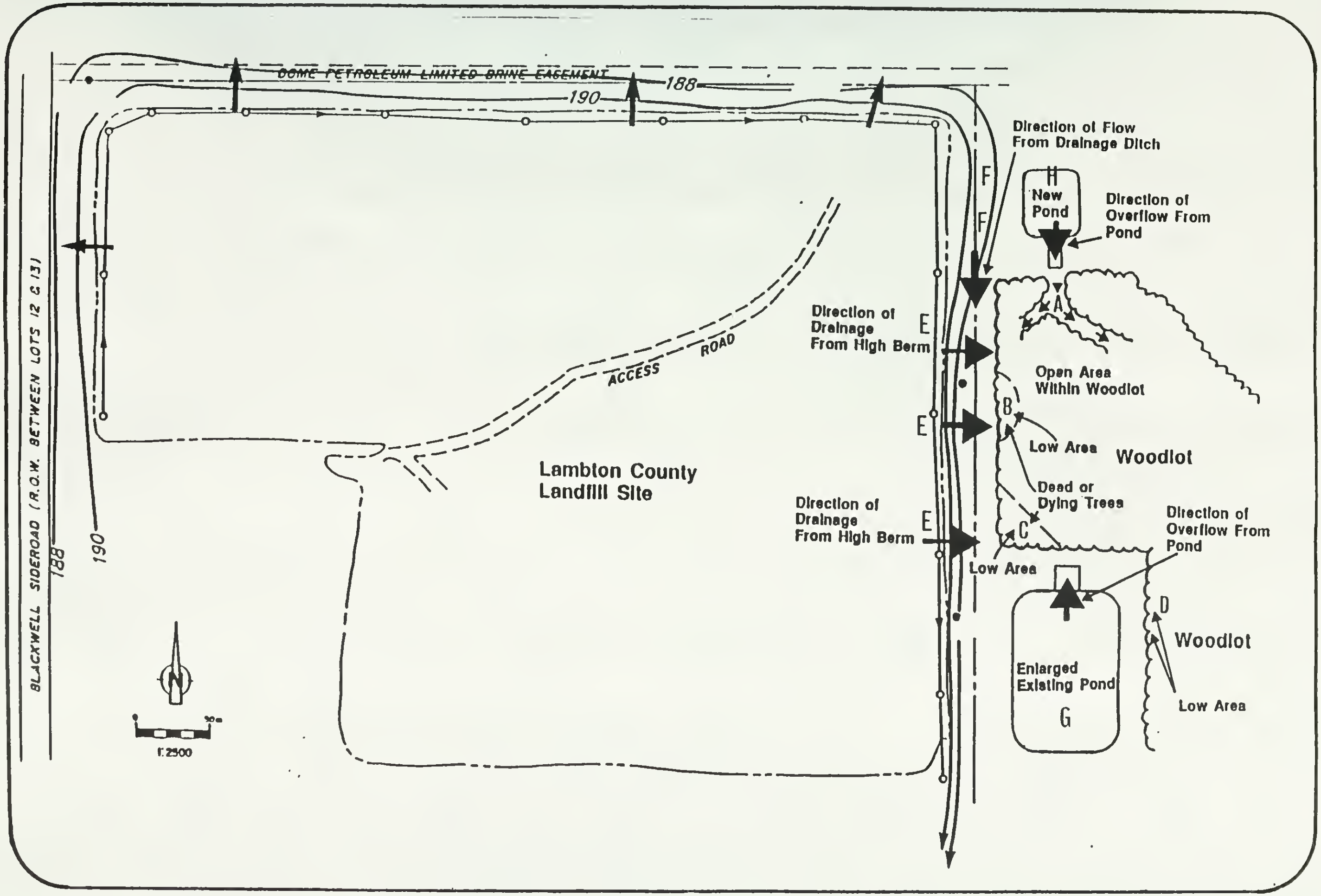

FIGURE: 2 Lambton County Landfill Site Showing Groundwater Potentiometric Surface